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**Author(s):** Perry, John Oliver

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# Student Opportunities in 2022 – An XTD-SS Perspective

John Perry, XTD-SS

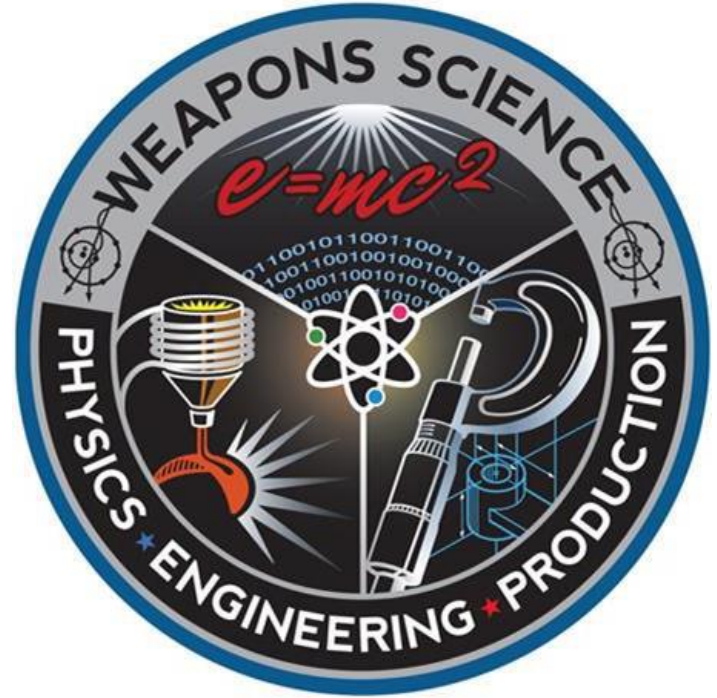
TODO PUT IN LAUR WHEN DONE

# Abstract

- Los Alamos National Laboratory's mission is to solve security challenges through simultaneous excellence. It accomplishes this through the shared efforts of a diverse group of people from many backgrounds. A crucial subset of these people are students that make their contributions in mathematics, physics, engineering, and more.
- In this presentation, I will describe LANL, its student programs, my division XTD, my group XTD-SS, and several relevant topics for students. I conclude with the following statement: LANL is a great place to apply skills learned in academia and time spent here is valuable for wherever your future career may lead you.

# Overview

- A little bit about the author
- LANL and its mission
  - A bit of historical context
- An overview of lab groups
- The student experience at LANL
  - Details of my own student experience
  - Details from a mentor's perspective
- XTD and XTD-SS
  - Our research and recent student experiences
- Question and answer session



# John Perry, XTD-SS, joperry@lanl.gov

## Professional Summary

- Education in nuclear engineering, BS, MS, PhD
  - Dissertation work on advanced applications of muon tomography
- My own LANL journey
  - Graduate research assistant in ISR-1
  - Postdoc in P-25
  - Staff member in P-21
  - Staff member in XTD-SS
- I really enjoy working with the many different types of skillsets and personalities found at LANL!

## Technical Interests

- Physics (all of it!)
- Software development (I'm a computer nut)
- Data acquisition hardware
- Radiography
- Modeling and simulation
- Mathematics
- Developing “simplified” models of the physical world

# LANL and Its Mission

- LANL's mission is to solve national security challenges through simultaneous excellence. It accomplishes this mission through the efforts of a diverse set of colleagues from many educational backgrounds.





# Los Alamos NATIONAL LABORATORY

## Mission Space

Deterrence and  
Stockpile Stewardship

Protecting Against  
Nuclear Threats

Emerging Threats and  
Opportunities

Energy Security  
Solutions



# The Design Laboratory for the Majority of the Nation's Nuclear Deterrent



Safe, Secure, and Effective!

# LANL History

- LANL has a rich history of brilliant personalities, stories, and scientific conquest throughout the course of almost 80 years
- Origin of the Manhattan Project, and birthplace of the atomic bomb
- Many contributions to the sciences, mathematics, and computational developments
- Check out the Bradbury Science Museum!
  - <https://www.lanl.gov/museum/>

➔ Also check out the many other historical notes found in literature, film, and news.



Historical Image of Fat Man1

# Our Heritage of Innovation

**1945:** Los Alamos scientists conduct the world's first nuclear test

**1945:** Nuclear weapons developed at Los Alamos help end World War II

**1946:** The Monte Carlo method devised by LASL scientists

**1946:** LASL completes the world's first plutonium fueled reactor

**1951:** First underground nuclear test conducted by LASL (according to DOE)

**1951:** LASL conducts the first nuclear test producing thermonuclear burn

**1952:** LASL conducts the first full scale thermonuclear test

**1953:** LASL conducts the first tactical nuclear weapons test

**1954:** The largest United States nuclear test conducted by LASL

**1956:** The existence of the neutrino proven by LASL scientists (Nobel Prize)

**1963:** The heat pipe is invented by LASL scientists

**1963:** LASL developed Vela satellites launched

**1967:** Gamma ray bursts first detected by Vela satellites

**1972:** LAMPF produces an 800 MEV beam

**1973:** LASL's Nuclear Safeguards Program begins

**1974:** LAMPF ships its first medical radioisotopes

**1979:** IHE first used in a stockpiled nuclear weapon

**1982:** GenBANK established at LANL

**1982:** LANL's Cray X MP named world's fastest computer

**1984:** LANL x ray detectors used on GPS satellites

**1988:** Center for Genome Studies established at LANL

**1988:** LANL participates in Joint Verification Experiment

**1990:** National High Magnetic Field Laboratory established at LANL

**1990:** LANL begins participation in experiments that ultimately confirm neutrino mass

**1992:** LANL conducts the last U.S. nuclear weapons test

**1995:** Chromosome 16 is mapped at LANL

**2002:** The first 3D full system weapons simulation is performed at LANL

**2008:** LANL's Roadrunner supercomputer breaks the petaflop barrier

**2009:** DARHT becomes the world's most powerful x ray machine

**2012:** LANL scientists produce a 100T non destructive magnetic field

**2012:** Curiosity Rover lands on Mars equipped with LANL instruments

**2015:** LANL scientists develop a breakthrough portable medical MRI device



*"We are one team, dedicated solely  
to the success of our Laboratory's  
national security mission."*

—Thom Mason, Laboratory Director



Laboratory Director  
**Thom Mason**



Director, Laboratory Staff  
**Frances Chadwick**



Deputy Director  
Science, Technology, & Engineering  
**John Sarrao**



Deputy Director  
Weapons  
**Robert Webster**



Deputy Director  
Operations  
**Kelly Beierschmitt**



ALD, Global  
Security  
**Nancy Jo Nicholas**



ALD, Chemical, Earth,  
& Life Sciences  
**J. Patrick Fitch**



ALD, Weapons Physics  
**Charlie Nakleh**



ALD, Weapons  
Engineering  
**James Owen**



ALD, ESHQSS  
**Michael Hazen**



ALD, Business  
Management  
**LeAnne Stribley**



ALD, Physical  
Sciences  
**Antoinette Taylor**



ALD, Simulation &  
Computation  
**Irene Qualters**



ALD, Weapons  
Production  
**John Benner**



Actinide Operations  
Director  
**Stacy McLaughlin  
(acting)**



ALD, Plutonium  
Infrastructure  
**Mark Anthony**



ALD, Capital Projects  
**Kathy Segala**



ALD, Facilities &  
Operations  
**Bret Simpkins**

# Organizational Structure and Divisions

- There are many divisions and groups at the laboratory
- They all are organized under the leadership of the tree to the right
- Examples include:
  - XTD – X Theoretical Design
  - P – Physics
  - T – Theoretical
  - ISR – Intelligence and Space Research

# Many Opportunities Exist at LANL for Students

- With its variety of divisions and groups, there are many opportunities to explore the sciences.
- Often students can work on a variety of projects, meet multiple future mentors, and find their own path throughout the organization
- Check out the LANL student site portal at:  
<https://www.lanl.gov/careers/career-options/student-internships/>

Scott Robbins



Emily Robinson



Cassandra Casperson



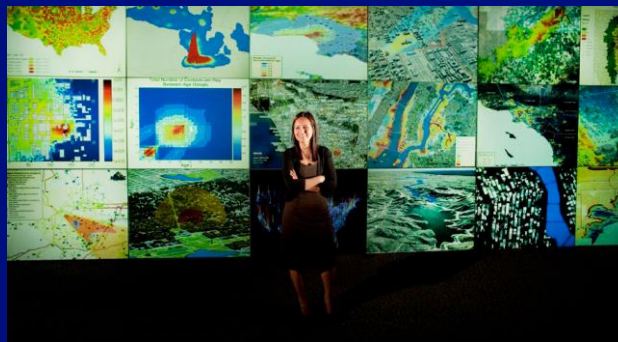
Josefina Salazar



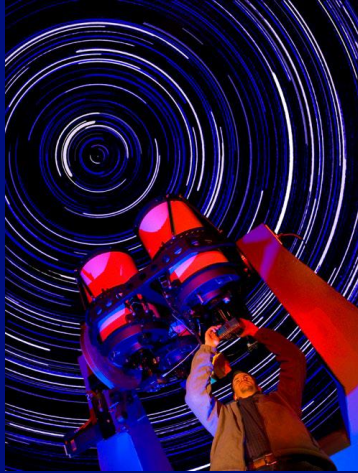
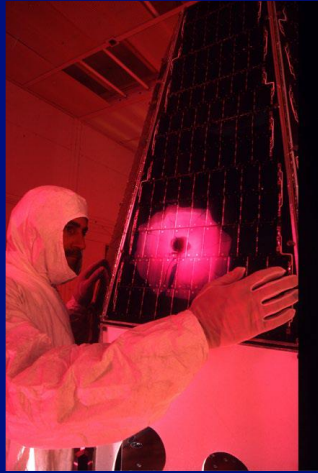
LANL Student Office Contacts

# A Sampling of Technical Fields Available at LANL

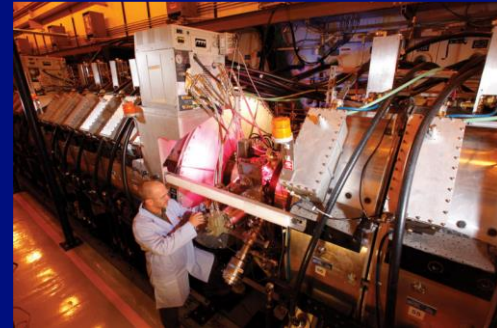
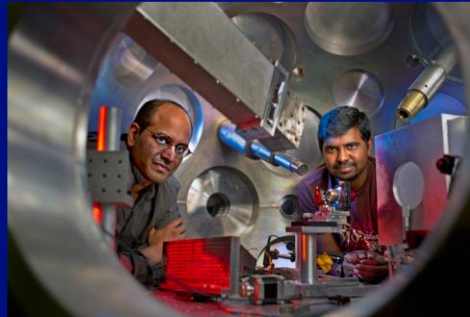
- Nuclear weapons design and certification
- Counter proliferation and non-proliferation ST&E
- High explosives research
- Cyber security and network infrastructure development
- Artificial intelligence and machine learning applications



# A Sampling of Technical Fields Available at LANL



- Nanotechnology research
- Mechanical, electrical, chemical, & nuclear engineering
- Materials science
- Computational physics and applied mathematics
- Bio research & mapping the human genome



# My Own Student Experience

- In 2009, I was working on my PhD in nuclear engineering at Purdue having recently finished my Masters in the same program
  - Life happened and I found myself searching for a different program/continuation of my career path
- I came to LANL as a post-masters GRA (graduate research assistant) in early 2010 and spent about a year with ISR-1
  - This was a great experience, I contributed to several projects and developed many long-lasting professional relationships
  - At this point I worked on data acquisition, Monte Carlo particle physics simulations, and so on
- As I wanted to complete my PhD work, my colleagues in ISR-1 connected me with P-25 and I began transitioning to that group
  - Over the years, I was able to contribute to many projects, restart my PhD, and conclude the academic requirements required for the program whilst working full time at the Laboratory
- This experience was perfect for me, and I am thankful for my mentors' time and their contribution to my education and career growth.

# My Own Mentoring Experience

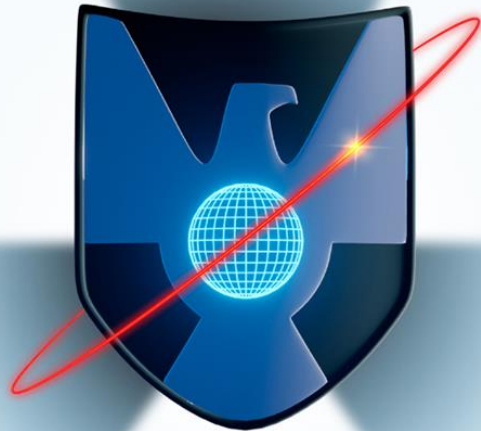
- Throughout the years, I co-mentored several undergraduate students prior to joining XTD-SS
- In XTD-SS, I have formally mentored 3 students and the experience has been valuable
  - These students brought important contributions to the projects they worked on
  - They taught me how to be a better mentor and teacher
  - Having been a LANL student in the past, it's interesting to experience the mentor role and contribute in that way
- Even during COVID-19, we were able to accommodate students' needs for remote work
- My most important goal for mentoring students is to provide them a pathway to succeed and grow professionally
  - This includes developing a social network in the lab when possible and finding the best possible fit for their talents/interests, even if they are not strictly aligned with my current projects

# XTD – X Theoretical Division

- XTD uses state-of-the-art scientific theoretical, numerical, and experimental tools and methods to understand nuclear weapon design, performance, safety and surety, outputs and effects
- 4 Groups in XTD
  - XTD-IDA – Integrated Design and Assessment
  - XTD-NTA – Nuclear Threat Assessment
  - XTD-PRI – Primary Physics
  - XTD-SS – Safety and Surety
- Vision
  - Provide the nation with robust nuclear designs to deter existing or emerging threats
- Mission
  - Design any nuclear explosive and meet any requirement
  - Assess any nuclear explosive scenario



# XTD-SS – Safety and Surety

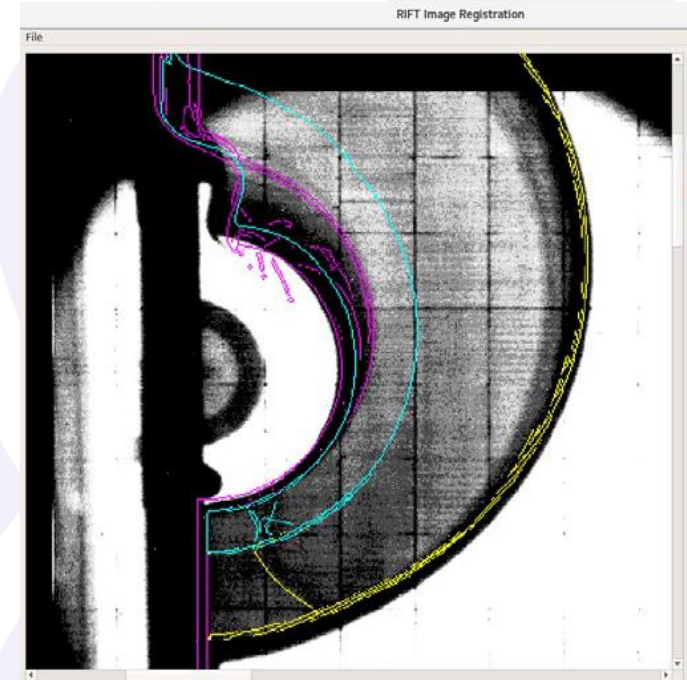


X THEORETICAL DESIGN  
**SAFETY AND SURETY**

- Mission
  - To assess the safety and surety of nuclear weapons
  - To provide solutions to global-security and conventional-munitions challenges
- What we do
  - We maintain and apply multidimensional numerical techniques for our mission
  - We use validated, verified physics models and methods
  - The quantification of uncertainties process is important in order to obtain accurate and timely solutions
  - Our success is measured by our customers within the nuclear weapons complex, DoD, and by the peer-review process

# Student Experiences in XTD-SS – Hannah Madsen

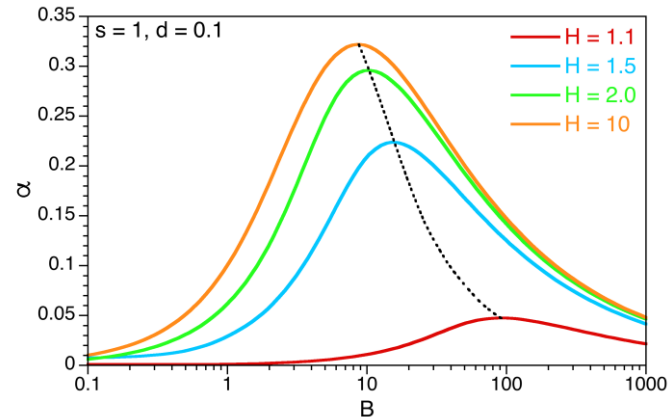
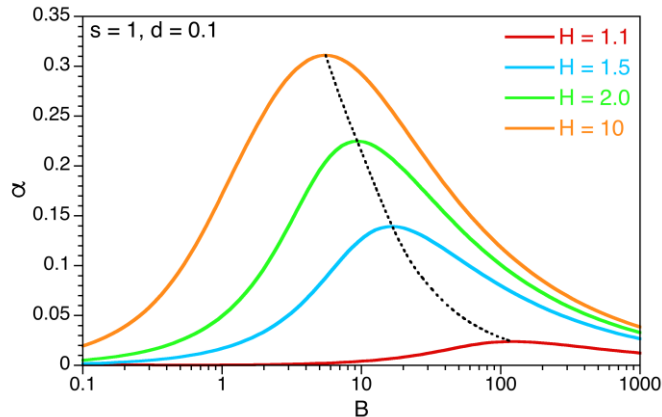
- Joined us as a remote student (undergrad) in January 2021
- Now pursuing graduate research at college
- Background in math and computer science
- Her projects included:
  - Development of a graphical user interface for comparing radiographic data with physics simulations
  - Characterization of a large data set from biological, air sampling sensors
    - 2 Publications
      - Bio-detection for the 21<sup>st</sup> Century, Data Exploration for Anomaly Detection (ADAv2)
      - GS-NSD DHS/CWM T&E Program Review



RIFT edge detection in an experiment of interest.

# Student Experiences in XTD-SS – Garrett Oren

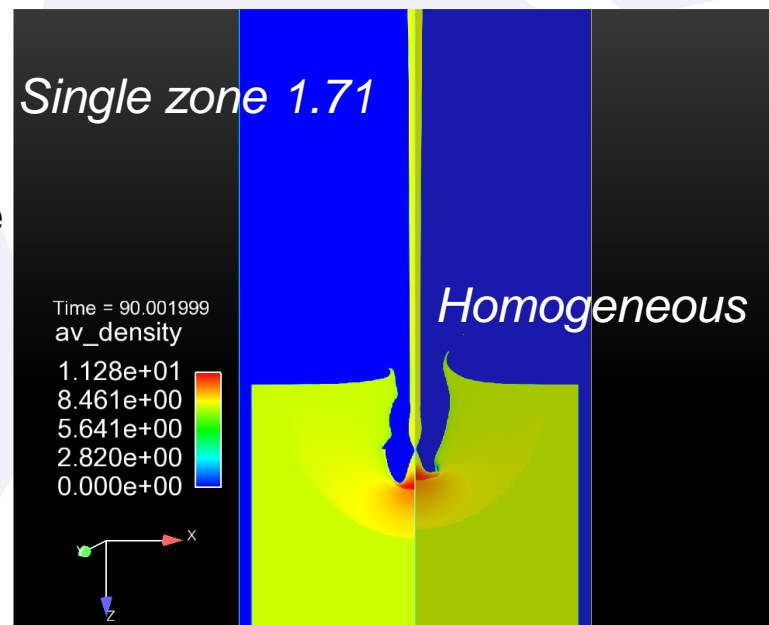
- Garrett Oren has been working with XTD-SS scientist Guillermo Terrones, previous XTD-SS scientist Tamra Heberling, and myself
- Recently, Garrett and Guillermo have published the following:
  - Finite Boundary Effects on the Spherical Rayleigh-Taylor Instability between Viscous Fluids (LA-UR-22-20717)



Several parametric studies as described in LA-UR-22-20717

# Student Experiences in XTD-SS – Irene Fang

- Irene worked with us as a post-bac student from 2019-2020
- She made valuable contributions to multiple projects, and through multiple collaborations, moved toward continuing her education at the University of Iowa
- Several of Irene's contributions included:
  - Predicting the effects of density gradients on hydrodynamic behavior of PBX9502 in Shaped Charges
  - Continuous integration and testing on several software projects
  - Developed modeling and simulation capabilities



Shaped Charge Simulation

LA-UR-19-31096

# Future Student Projects (from my point of view)

- My work generally is computationally focused
  - Modeling and simulation
  - Data analysis
  - Software development
  - Tons of little programs and connections across the lab complex
- I typically look for mathematicians, engineers, and physicists
  - Usually with a strong computational background and the ability to program
- Currently, I have projects available for students involving:
  - Software frameworks that assist modeling and simulation
  - Bio projects and large data set analysis
  - Detector data fusion projects involving synthetic and real data
- While not every student is interested in the above, there is often a fit that can be found through the lab and its diverse, technical experts

# Questions and Discussion

- Thank you!
- Some additional resources are:
  - <https://www.lanl.gov/>
  - <https://www.lanl.gov/careers/career-options/student-internships/>
- Our student office is a great and helpful resource, check out their website listed above for additional info

